# 2002
# WIND FEASIBILITY ANALYSIS GUIDELINES

**For use with Wind Feasibility Analysis contract dates after January 1, 2002**

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## INTRODUCTION

### Building Energy Management Programs

The purpose of the Building Energy Management (BEM) Programs as well as a primary objective of the Energy Bureau, is to improve Iowa's energy efficiency and to promote the use of renewable energy technologies. To these ends, the BEM Programs provide access to the financing needed to implement cost-effective wind turbine projects. The BEM Programs have established arrangements with private sector legal and financial resources that make the necessary funds available. Clients cannot access BEM Program financing unless the analysis is conducted according to the technical standards described in this Guideline.

Iowa Code Chapter 473 directs that loans be made for all cost-effective energy management improvements identified in a comprehensive engineering analysis. Refer to the *Guidelines for Cost-Effective Energy Management Improvement Projects* for the Program's definition of "cost-effective".

## WIND FEASIBILITY STUDY GUIDELINES

Wind feasibility reports are required to be conducted in a two phase process under two separate client-analyst contracts. Phase 1 is a preliminary assessment based on available wind data. The preliminary assessment is an information gathering report which is used to determine project feasibility prior to on-site wind resource monitoring. Information gathered is to be used as part of the full Phase 2 assessment, if warranted. The analyst is to provide conclusions and recommendations before conducting the second phase analysis.

Phase 2 is a detailed investigation of site-specific wind data. On-site monitoring is conducted to verify site wind resources and to provide a thorough economic assessment of the project.

## PRELIMINARY ASSESSMENT REPORTS – PHASE 1

### Introduction

The format of a Phase 1 wind feasibility analysis report is to be similar to the format of these guidelines. Information and calculations are to be clearly presented and understandable to all parties in the process including technical, financial, and school personnel. Reports are to be stand-alone documents, meaning that they are to include all information needed for the review and for future reference. The Department of Natural Resources, Energy Bureau requires, as a minimum, the following information in all preliminary wind feasibility studies associated with the Bureau's programs.

### Executive Summary

The Executive Summary is to include an explanation of the purpose of the report, a synopsis of the important conclusions of the report (including simple payback), and the analyst's recommendations for Phase 2 analysis. A description of known legal barriers and environmental impacts (i.e. noise, habitat) should be summarized in this section. Significant project risks should also be discussed.

**Site Description**
The report should provide a description of the site, obstructions, and topography. The site description shall include a description and photographs of surroundings and wind disturbances, i.e. trees, buildings, hills, and their effects. The description should include wind regime classification (refer to refer to the Iowa Energy Center website at www.energy.iastate.edu/).

**Electric Utility Information**
The following is required for the preliminary assessment of wind turbine feasibility:

A. Annual electric consumption history for the facility from the previous fiscal year (July 1 to June 30).
B. Description of the electric utility's method of accounting for metered production and utility buy-back rate, if known. If not known, provide a description of the most likely scenario and an explanation justifying the recommendation for analysis.

**Site Wind Monitoring**
Wind resource measurements are not required. Refer to the Site Data section below.

**Site Data**
Site-specific wind resource monitoring is not required for preliminary assessment reports. Data that is used must be from a neighboring site, National Weather Service airport wind data, the Iowa Energy Center's Wind Speed and Turbine Output calculator (http://www.energy.iastate.edu), or another prior approved modeling software program (contact the Department). A minimum of one full year of data, correlated to the proposed site, is required. Provide copies of the output in the feasibility report.

Data recorded from a height that varies from the proposed turbine hub height must be adjusted (per AWEA standards) using the Power Law and corresponding shear factor ($\alpha$) for that location (or $\alpha = 1/7$ if the shear factor for the site is not known).

**Energy Output/Energy Cost Savings**
The analyst is to provide justification for the turbine size being evaluated. It is recommended, but not required, that several options be evaluated.

A. Calculate the turbine output using the wind speed frequency distribution (original or adjusted) (refer to Site Data section) and generic power curve(s).
B. Savings should be calculated based on the purchase agreement with the utility company. If the type of agreement is not known, then both of the following scenarios must be evaluated.
    1. Net Billing Agreement - Determine energy savings from monthly facility consumption history and monthly estimated wind energy production.
    2. Non-Net Billing Agreement - Determine energy savings from matching diurnal wind power production with the facility's diurnal loading. This method will establish hourly energy consumed and energy sold to the utility.

**Cost Estimates**
All cost estimate data are to be clearly presented. Rule-of-thumb cost estimates are acceptable in the preliminary assessment. Consequently, cost components do not need to be broken out nor do references for cost data need to be provided. However, cost data should include all of the following:

A. Material Costs: turbine, tower, controls, electrical system, and cost of freight.
B. Installation Costs: permitting or licenses, foundation, site preparation (including excavation, grading, fences, and surveying), crane (if necessary), and labor.
C. Design and Project Management Costs
    1. Engineering Design
    2. Construction Management
    3. Project Management
    4. Commissioning
D. Operation and Maintenance Costs
    1. Annual or routine maintenance to system: labor and material.
    2. Part Replacement: stock and labor for frequently replaced parts.

**Risk Assessment**
The study shall discuss the risks pertaining to the project's economic performance. This discussion can be more general in nature for the preliminary assessment unless specific issues relating to the site are known. This analysis will evaluate risks relating to uncertainties including:

- The site selected (changes in wind obstructions near the site).
- Loss of net metering.
- Loss of the Renewable Energy Production Incentive (REPI).
- Unbundling of or changes in electric rates.
- Deregulation of the electric utility industry.
- Long simple payback.
- Any other risk pertaining to the economic performance of the specific project.

**Economic Analysis**
The preliminary assessment shall provide an economic analysis based on the most likely scenario at the time of the study (current social, political, environmental, and economic environments). In order to clarify project risks, assessment of other possible scenarios is recommended but not required.

The preliminary assessment is to provide an evaluation of each wind turbine alternative using the simple payback method. The simple payback method determines the length of time required for the cumulative savings from the project to recover the initial investment and other accrued costs, without accounting for the time value of money.

A discussion of the impact to institution cash flow is recommended but not required.

## Appendix – Supplemental Information

Material not located in the main body of the assessment is to be placed in this section including:

**Qualifications**

If not currently on the BEM Programs's list of wind analysts, provide detailed list of qualifications and references to perform wind turbine feasibility analysis.

**Project Identification** form (see page 13)

**Client-Analyst Contract**

**Electric Utility Information**

**Electric Utility Agreement**

**Site Data**

**Calculations**

**Power Curves**

## FULL FEASIBILITY REPORTS – PHASE 2

### Introduction
The format of a Phase 2 wind feasibility analysis report is to be similar to the format of these guidelines. Information and calculations are to be clearly presented and understandable to all parties in the process including technical, financial, and school personnel. Reports are to be stand-alone documents, meaning that they are to include all information needed for the review and for future reference. The Department of Natural Resources, Energy Bureau requires, as a minimum, the following information in all wind feasibility studies associated with the Bureau's programs.

### Executive Summary
The Executive Summary is to include an explanation of the purpose of the report, a synopsis of the important conclusions of the report (including payback and life cycle cost), and the analyst's recommendations for wind turbine installation. A description of known legal barriers and environmental impacts (i.e. noise, habitat) should be summarized in this section. Significant project risks should also be discussed.

### Site Description
The report should provide a thorough description of the site, obstructions, and topography. The site description shall include:

A. Schematic of grounds and proposed turbine location.
B. Description and photographs of surroundings and wind disturbances, i.e. trees, buildings, hills, and their effects. Description should include wind regime classification (refer to the Iowa Energy Center website at www.energy.iastate.edu/).
C. It may be useful to include USGS satellite photographs of the site. Most of the available photos are several years old and may not show all wind disturbances, so a description of changes to the site would be required. Satellite photos can be obtained on-line from the following website:

http://terraserver.homeadvisor.msn.com/default.asp

### Electric Utility Information
The analyst is to contact the electric utility for information concerning electric grid interconnect requirements and obtain a draft of the electric utility agreement. The following is required for the assessment of wind turbine feasibility:

A. Tabulated monthly electric consumption history for the facility including amount and cost from the previous fiscal year (July 1 to June 30) (see form on page 14).
B. Photo copies of monthly electric bills for the previous fiscal year (tabulated in A).
C. Description of the electric utility's method of accounting for metered production and utility buy-back rate.
D. Photocopy of the utility's (draft) agreement, including buy-back rate and utility contact information.

### Site Wind Monitoring
Measurements shall be taken in accordance with American Wind Energy Association (AWEA) standards and as close to the intended turbine location and hub height as possible (refer to the Site Data section for adjustments of data for hub height). At a minimum, the anemometer shall be at a height of 33 feet. The following minimum requirements apply to all feasibility reports:

A. Data collected shall include: hourly average wind speeds and direction, frequency distribution, and monitoring height.
B. Anemometer must be located on an arm extending from the tower toward the prevailing wind. Arms attached to a lattice tower must extend out 3 times tower width. Arms attached to a solid tower must extend 6 times tower width.
C. Two anemometers are recommended per site, but not required.
D. Anemometer(s) shall be calibrated before and after monitoring (or at intervals recommended by equipment manufacturer). Describe discrepancies and method used to correct data. Provide data correction calculations.

**Site Data**

There are three possible options for site data requirements described below. Only under ideal site conditions and with prior Department approval will Option 3 for non-site specific wind data be allowed in the determination of project feasibility.

Wind resource monitoring not conducted at the proposed turbine hub height must be adjusted (per AWEA standards) using the Power Law and corresponding shear factor ($\alpha$) for the proposed location (or $\alpha = 1/7$ if the site shear factor is not known).

The three options for site data collection are as follows:

A. Option 1 - One year site specific monitoring

   Compare the one year of site-specific data collected with neighboring historical data to determine variation from a normal year. (Refer to National Weather Service airport weather station or contact the Iowa Energy Center (http://www.energy.iastate.edu) for the nearest wind monitoring data). If not within 90% correlation, make adjustments and describe methods used. Adjustments must conform to AWEA standards.

B. Option 2 - Less than one year site specific monitoring (minimum of 3 months).

   Provide justification for less than one year site-specific monitoring. Correlate the less than one year of data collected with a neighboring historical site. (Refer to National Weather Service airport weather station or contact the Iowa Energy Center (http://www.energy.iastate.edu) for the nearest wind monitoring data). Describe and show the method used. Methods must conform to AWEA standards.

C. Option 3 – Non-site specific wind data

   This option is available with prior Department approval only for ideal site conditions. Provide justification for this option and the methodology used. Include neighboring wind data, 1 year minimum, and correlate to the proposed site.

**Energy Output/Energy Cost Savings**
The analyst is to provide justification for the turbine size being evaluated. It is recommended, but not required, that several options be evaluated.

A. Calculate turbine output using the wind speed frequency distribution (original or adjusted) (refer to Site Data section) and generic power curve(s).
B. Savings must be calculated based on the purchase agreement with the utility company. If the type of agreement is not known, then both of the following scenarios must be evaluated.
    1. Net Billing Agreement - Determine energy savings from monthly facility consumption history and monthly estimated wind energy production.
    2. Non-Net Billing Agreement - Determine energy savings from matching diurnal wind power production with facility's diurnal loading. This method will establish hourly energy consumed and energy sold to the utility.

**Cost Estimates**
All cost estimate data are to be clearly presented. Cost components such as labor, material, etc. must be broken out. References for cost data shall be provided.

A. Material Costs: turbine, tower, controls, electrical system, and cost of freight.
B. Installation Costs: permitting or licenses, foundation, site preparation (including excavation, grading, fences, and surveying), crane (if necessary), and labor.
C. Design and Project Management Costs
    1. Engineering Design
    2. Construction Management
    3. Project Management
    4. Commissioning
D. Operation and Maintenance Costs
    1. Annual or routine maintenance to system: labor and material.
    2. Part Replacement: stock and labor for frequently replaced parts.

**Risk Assessment**
The study shall thoroughly investigate and discuss the risks pertaining to the project economic performance. This analysis will evaluate risks relating to uncertainties including:

- The site selected (changes in wind obstructions near the site).
- Loss of net metering.
- Loss of the Renewable Energy Production Incentive (REPI).
- Unbundling of or changes in electric rates.
- Deregulation of the electric utility industry.
- Long simple payback.
- Any other risk pertaining to the economic performance of the specific project.

Careful economic assessment of risks related to each scenario is recommended but not required. Refer to the Economic Analysis section.

**Economic Analysis**
Evaluation of every project risk introduces an exorbitant number of possible scenarios. Therefore, the study shall provide an economic analysis based on the most likely scenario

(current social, political, environmental, and economic environments). In order to clarify project risks, assessment of other possible scenarios is recommended but not required.

The report is to provide an evaluation of each wind turbine alternative using both the simple payback and life cycle cost analysis methods. The simple payback method determines the length of time required for the cumulative savings from the project to recover the initial investment and other accrued costs, without accounting for the time value of money.

The life cycle cost analysis method determines the total discounted dollar costs of owning, operating, maintaining, and disposing of each project alternative evaluated over a 25 year study period. The life cycle cost of the "do nothing" option must first be evaluated to determine if any of the project alternatives are cost effective.

Cash flow analysis is recommended but not required.

## Appendix – Supplemental Information

Material not located in the main body of the assessment is to be placed in this section including:

**Qualifications**

If not currently on BEM Program list of wind analysts provide detailed list of qualifications and references to perform wind turbine feasibility analysis.

**Project Identification** form (see page 13)

**Client-Analyst Contract**

**Electric Utility Information**

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**Calculations**

**Power Curves**

## Qualified Wind Engineering Analyst Statements

Institution _____ Building _____

This section consists of the Analyst Statements that serve as a checklist for some basic guideline requirements. **All items are to be checked off or indicated as not applicable**.

This report is a ___ Phase 1 Preliminary Assessment ___ Phase 2 Comprehensive Assessment (check one)

**Introduction:**
__ Format similar to the Wind Feasibility Guidelines.
__ Report is a stand-alone document and includes all information needed for review and future reference.

**Executive Summary:**
__ Narrative summary including purpose of the report, conclusions, and recommendations.
__ Discussion of legal and environmental impacts, and significant project risks.

**Site Description:**
__ Narrative description and photographs of proposed site. Discussion of the impact of obstructions and topography.
__ Site schematic (Phase 2) including proposed turbine location and wind disturbances.

**Electric Utility Information:**
__ Description of utility's anticipated (Phase 1) or proposed (Phase 2) method of accounting for metered production and utility buy-back rate.
__ Electric consumption history (annual or monthly for Phase 1) (monthly for Phase 2)
__ Photocopies of the energy bills for the previous fiscal year and utility rate tariffs (Phase 2)
__ Photocopy of the electric utility agreement including contact information (Phase2)

**Site wind monitoring and site data:**
__ Description of monitoring methodology (complies with AWEA standards)
__ Wind speed frequency distribution data as well as raw monitoring data
__ Description and discussion of data discrepancies, correlations, and methodology for corrections
__ Data height correction calculations

Phase 2 site monitoring data: ___ Option 1 ___ Option 2 ___ Option 3 (only with prior approval) (check one)

**Energy output, energy cost savings, cost estimates, risk assessment, economic analysis:**
__ Power curves
__ Estimated energy production
__ Cost estimates
__ Risk assessment
__ Simple payback
__ Life cycle cost analysis (Phase 2) versus "do nothing" option

**APPENDIX**
__ Analyst qualifications
__ Identification Page
__ Client-Analyst contract
__ Utility agreement (Phase 2)

## Qualified Wind Analyst Certification

Institution _____ Building _____

### Certificate of Responsibility

***Professional Engineer***

| | |
|---|---|
| **SEAL** | I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.<br><br>(signature) _____ (date)<br>Printed or typed name<br><br>My license renewal date is December 31, _____.<br><br>Pages or sheets covered by this seal:<br>_____<br>_____<br>_____<br>_____ |

## Identification Page

Institution _____ Building _____

**Institution**
(CSD, AEA, Comm. Coll., Hospital, Non-profit, Local Government, State Facility or Agency)

Name _____
Address _____ County _____
City _____ State _____ Zip _____
Contact Person _____ Title _____
Telephone _____

**Building**

Name _____
Address _____ County _____
City _____ State _____ Zip _____
Contact Person _____ Title _____
Telephone _____

**Energy Supplier**

Electricity _____

**Qualified Wind Engineering Analyst and Technical Support Personnel**

Firm name _____
Analyst's name _____
Support Person _____
Support Person _____
Telephone _____
Fax _____

## Electric Consumption History

Institution _____ Building _____

| **Fiscal Year** _____ | **Electricity** | |
|---|---|---|
| **Month** | **kWh** | **Cost** |
| July | | |
| August | | |
| September | | |
| October | | |
| November | | |
| December | | |
| January | | |
| February | | |
| March | | |
| April | | |
| May | | |
| June | | |
| **Total** | | |

## Life Cycle Cost Analysis - Do Nothing Option

Institution _____ Building _____

Current kWh/year consumed: _____kWh (kWh)

Current Price of Electricity: $_____/kWh ($/kWh)

Study Period: _____years

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LCC Calculation

LCC = $[(kWh)\cdot(\$/kWh)]\cdot(UPV)^*_{study\ period}$

LCC = $_____

Notes:

SPV - Single Present Value Factor (nonfuel items)
UPV - Uniform Present Value Factor (nonfuel items)
UPV* - Modified Uniform Present Value Factor (adjusted for fuel price escalation)

Use FEMP indices only.

## Life Cycle Cost Analysis - Wind Option

Institution _____ Building _____

Estimated Purchase and Installation Costs: $ _____ (P&I)

Estimated Salvage/Residual Value: $_____ (SAL)

Additional Energy Produced and Sold to Utility: _____ kWh $(kWh)_{produced}$

Additional Energy Purchased from Utility: _____ kWh $(kWh)_{purchased}$

[1]Current Price of Electricity: $_____/kWh ($/kWh)

Annual Maintenance Costs: $_____ (AM)

Repair and Part Replacement Stock: $_____ every_____ years (R&R)

Useful Life: _____ years

Study Period: _____ years

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LCC Calculation

For additional energy produced and sold to the utility:

$$LCC = (P\&I) - (SAL)\cdot(SPV)_{study\ period} - (kWh)_{produced}\cdot(\$/kWh)\cdot(UPV)^*_{study\ period} + (AM)\cdot(UPV)_{study} + (R\&R)\cdot(SPV)_{R\&R\ year}$$

LCC = $_____

For additional energy purchased from utility:

$$LCC = (P\&I) - (SAL)\cdot(SPV)_{study\ period} + (kWh)_{purchased}\cdot(\$/kWh)\cdot(UPV)^*_{study\ period} + (AM)\cdot(UPV)_{study} + (R\&R)\cdot(SPV)_{R\&R\ year}$$

LCC = $_____

1. For additional energy produced and sold to the utility, use the buy back rate ($/kWh) agreed upon with the utility. For energy purchased, use the current purchasing rate ($/kWh).

## Life Cycle Costing

An explanation of Life Cycle Cost Analysis (LCCA) can be found in the Life-Cycle Costing (LCC) Manual for the Federal Energy Management Program, NIST Handbook 135, 1995 edition. Current indices can be found in the Annual Supplement to NIST Handbook 135.

Rates are updated each April. The Annual Supplement to NIST Handbook 135 document (which include current rates and the current version of the BLCC computer program) may be downloaded from:

http://www.eren.doe.gov/femp/techassist/softwaretools/softwaretools.html

FEMP rates are to be used (do not use Office of Management and Budget (OMB) rates). Analysts without internet access or analysts unclear on the appropriate rates to use may contact the Energy Bureau at (515) 281-6559.

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